

FIG. 1

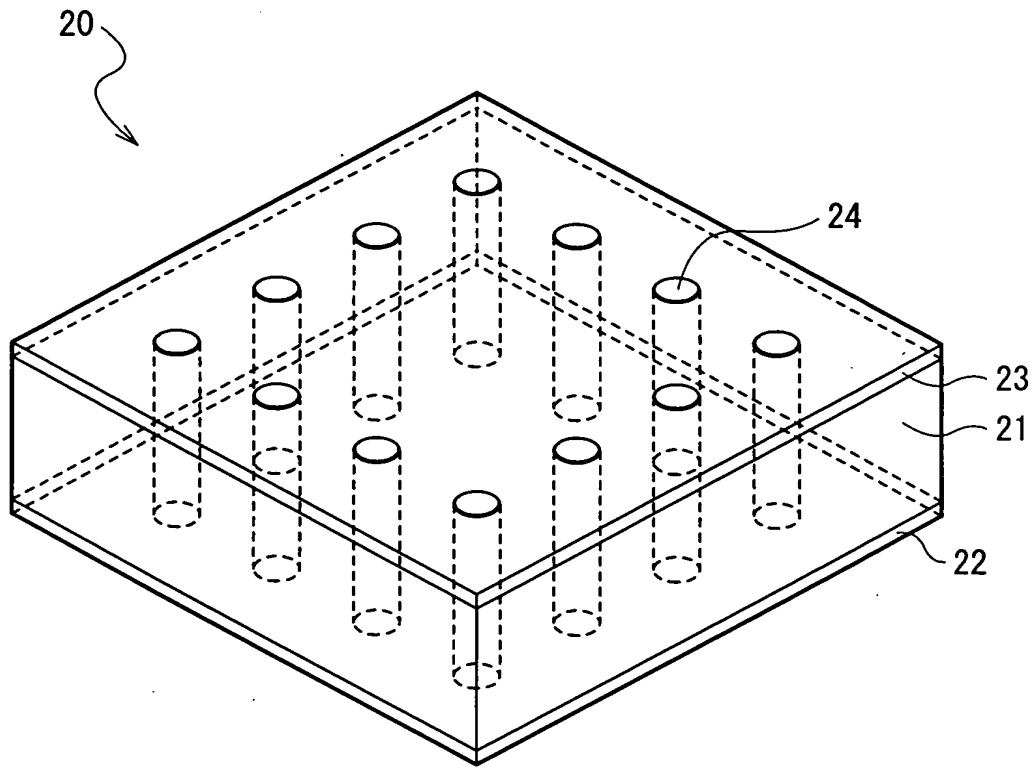


FIG. 2

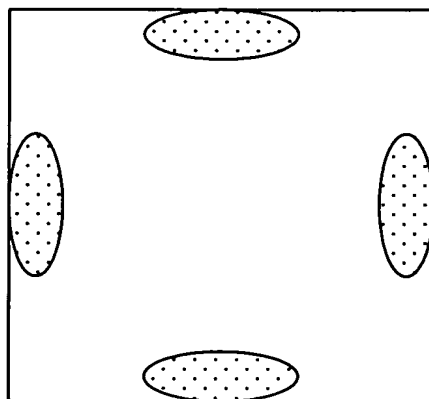


FIG. 3

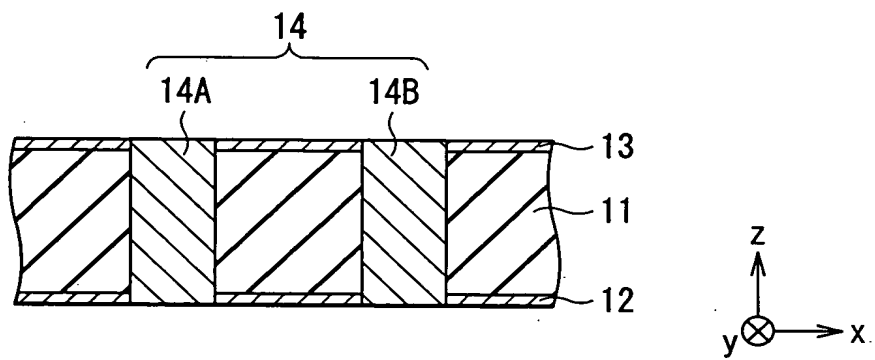


FIG. 4

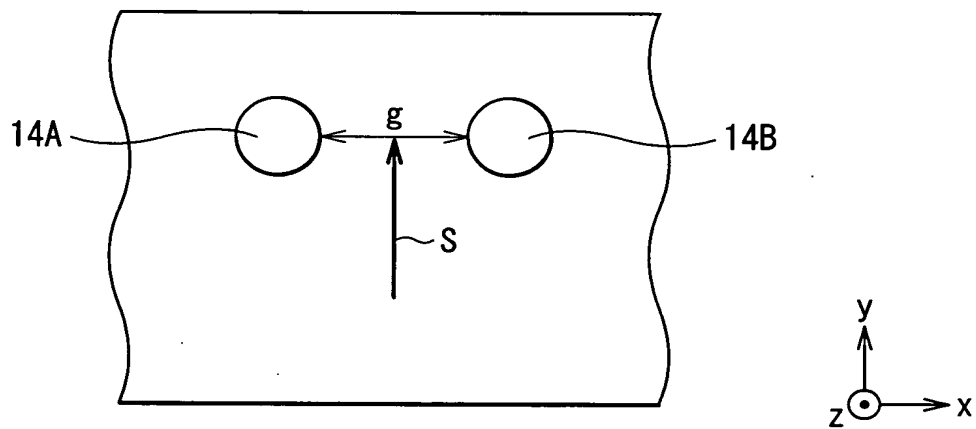


FIG. 5

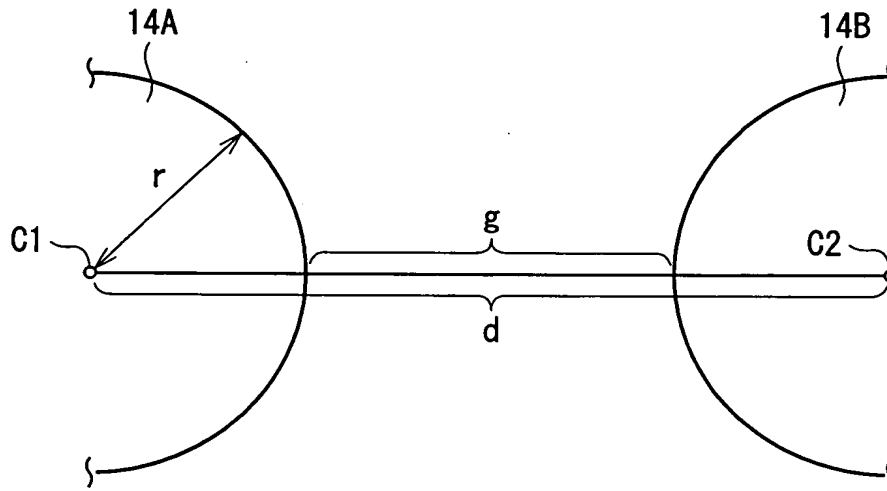


FIG. 6

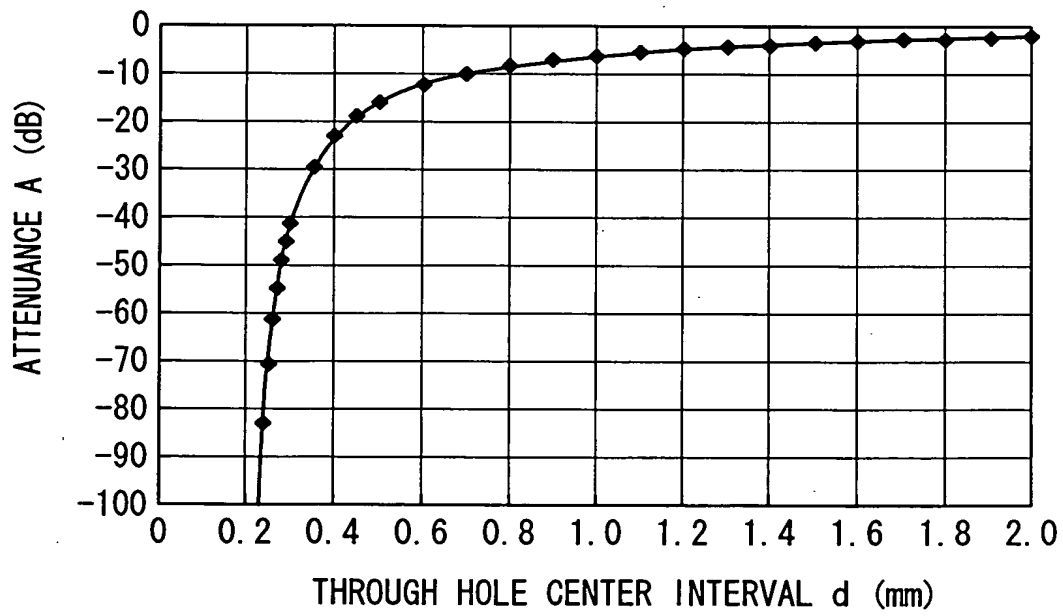


FIG. 7

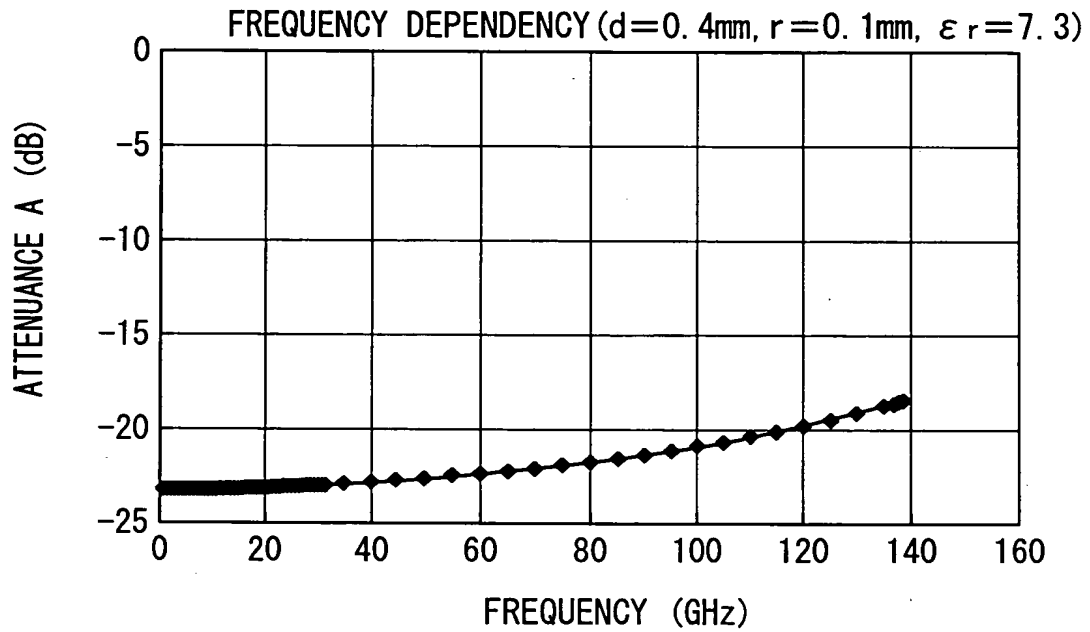


FIG. 8

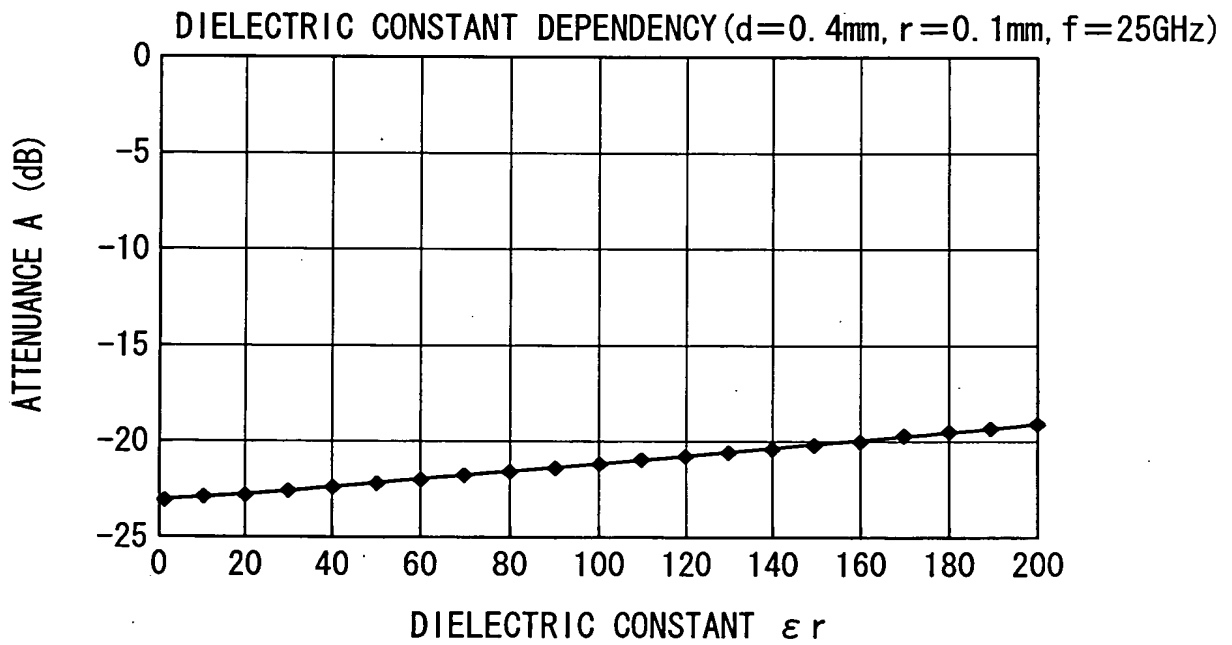


FIG. 9

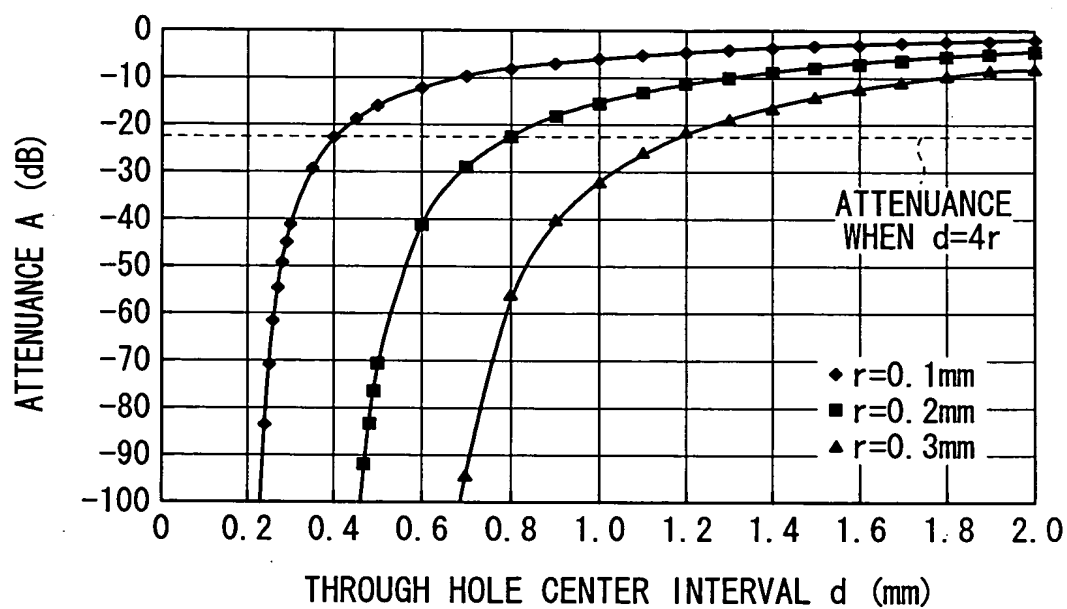


FIG. 10

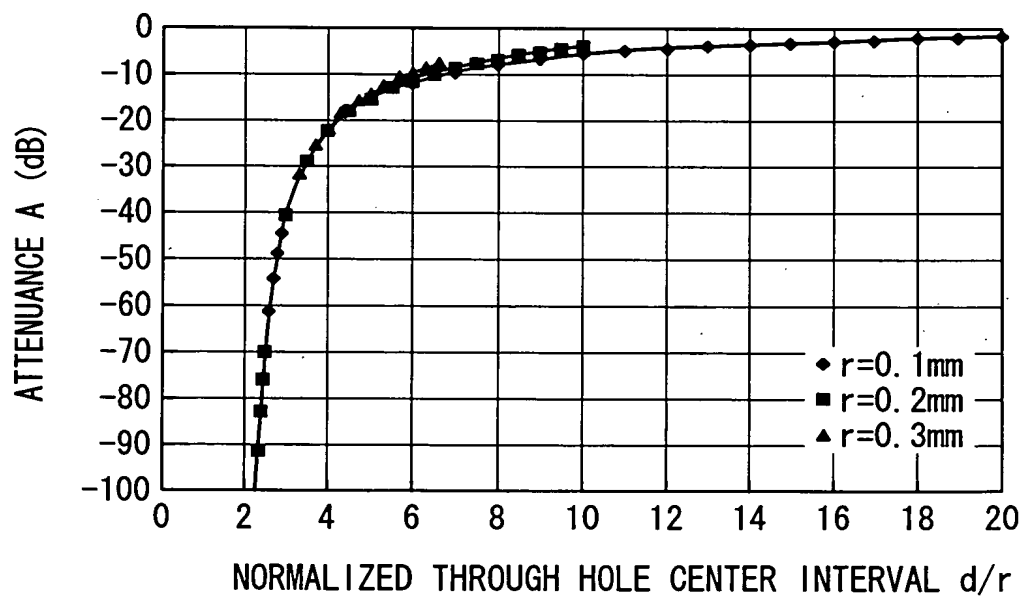


FIG. 11

FIG. 12A case 1

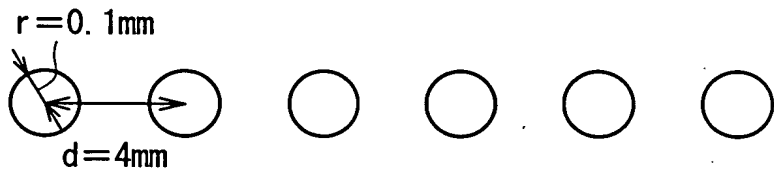


FIG. 12B case 2

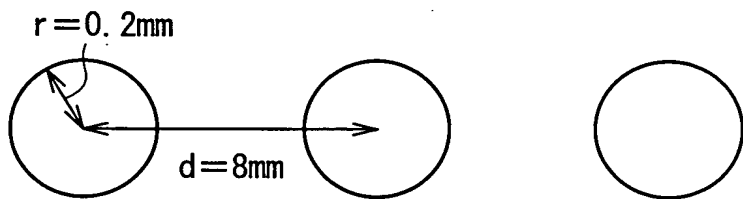


FIG. 12C case 3

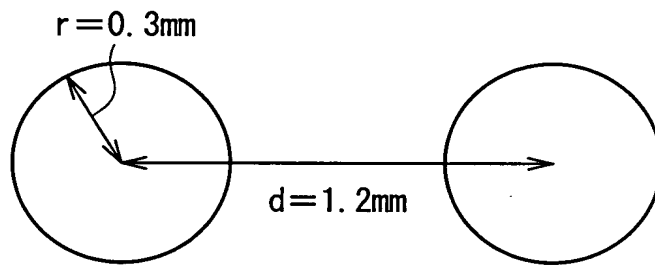


FIG. 13A

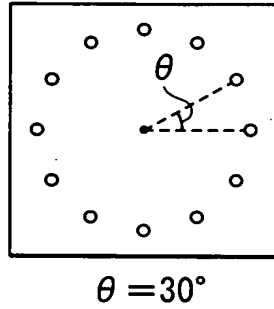


FIG. 13E

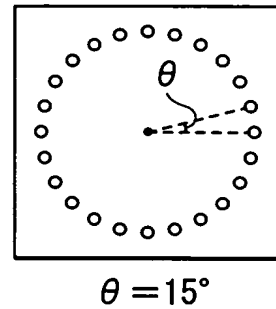


FIG. 13B

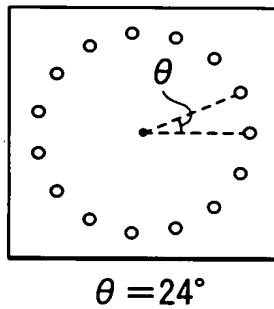


FIG. 13F

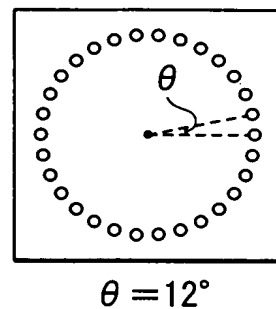


FIG. 13C

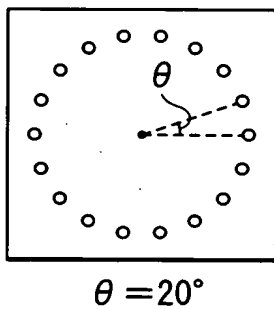


FIG. 13G

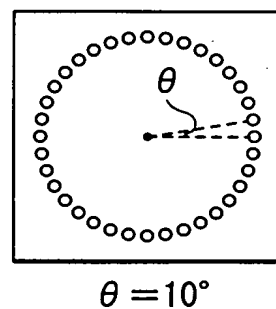
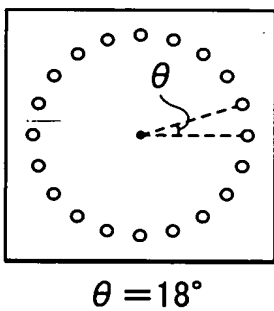


FIG. 13D



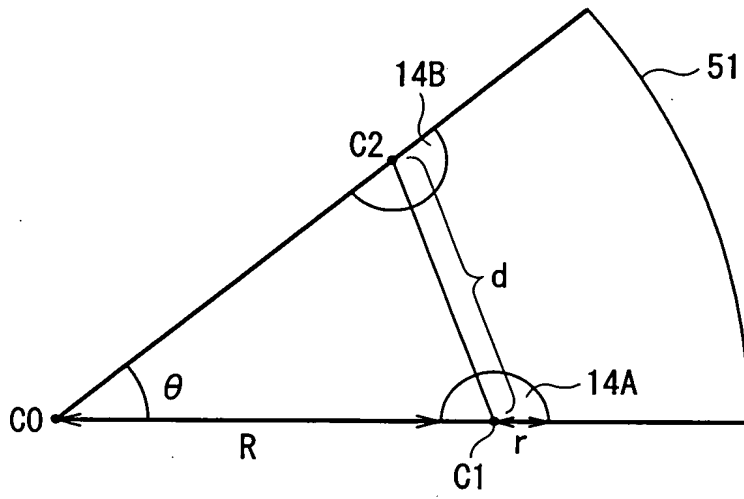


FIG. 14

FIG. 15A

THROUGH HOLE RADIUS $r=0.1\text{mm}$ RESONATOR THICKNESS $h=0.2\text{mm}$

θ (degree)	f (GHz)	Q	f _r (GHz)	Q _r	d (mm)	A (dB)
30	22.99	275.10	22.87	20.66	0.90	-6.95
24	23.55	283.02	23.51	63.97	0.73	-9.22
20	23.89	289.16	23.88	146.49	0.62	-11.75
18	24.05	291.62	24.04	200.22	0.56	-13.60
15	24.27	294.96	24.27	273.15	0.47	-17.83
12	24.47	298.87	24.47	296.69	0.37	-25.93
10	24.59	300.99	24.59	300.97	0.31	-37.48
CYLINDER (THEORETICAL VALUE)	24.98	307.80	24.98	307.80		

FIG. 15B

THROUGH HOLE RADIUS $r=0.1\text{mm}$ RESONATOR THICKNESS $h=0.3\text{mm}$

θ (degree)	f (GHz)	Q	f _r (GHz)	Q _r	d (mm)	A (dB)
30	23.00	379.75	22.89	21.06	0.90	-6.95
24	23.56	393.95	23.53	68.68	0.73	-9.22
20	23.90	403.31	23.89	167.71	0.62	-11.75
18	24.06	407.36	24.05	249.22	0.56	-13.60
15	24.28	414.80	24.28	368.46	0.47	-17.83
12	24.48	421.00	24.48	418.58	0.37	-25.93
10	24.60	425.28	24.60	425.54	0.31	-37.48
CYLINDER (THEORETICAL VALUE)	24.98	438.62	24.98	438.62		

FIG. 15C

THROUGH HOLE RADIUS $r=0.1\text{mm}$ RESONATOR THICKNESS $h=0.4\text{mm}$

θ (degree)	f (GHz)	Q	f _r (GHz)	Q _r	d (mm)	A (dB)
30	23.01	469.69	22.89	21.38	0.90	-6.95
24	23.56	490.35	23.53	70.88	0.73	-9.22
20	23.91	504.42	23.90	181.17	0.62	-11.75
18	24.07	510.85	24.06	280.23	0.56	-13.60
15	24.29	520.06	24.29	451.90	0.47	-17.83
12	24.49	531.07	24.49	525.72	0.37	-25.93
10	24.61	535.10	24.61	528.15	0.31	-37.48
CYLINDER (THEORETICAL VALUE)	24.98	556.98	24.98	556.98		

θ (degree)	r/d
30	0.0556
24	0.0683
20	0.0812
18	0.0899
15	0.1073
12	0.1336
10	0.1600

FIG. 16

θ (degree)		
r=0.1mm	r=0.2mm	r=0.3mm
30.00	58.73	88.66
24.00	46.40	68.30
20.00	38.42	55.92
18.00	34.48	49.97
15.00	28.64	41.27
12.00	22.85	32.79
10.00	19.01	27.22

FIG. 17

THROUGH HOLE RADIUS $r=0.2\text{mm}$ RESONATOR THICKNESS $h=0.2\text{mm}$

θ (degree)	f (GHz)	Q	f _r (GHz)	Q _r	d (mm)	A (dB)
58.73296	21.19	268.55	20.14	13.27	1.62	-6.76
46.39951	22.24	276.90	21.91	34.90	1.38	-9.09
38.41832	22.91	283.48	22.81	92.58	1.18	-11.72
34.48327	23.22	286.83	23.17	151.70	1.08	-13.64
28.63711	23.65	291.86	23.65	252.02	0.91	-17.99
22.84636	24.04	296.54	24.04	293.00	0.74	-26.29
19.01041	24.27	299.26	24.27	299.15	0.62	-38.10
CYLINDER (THEORETICAL VALUE)	24.98	307.80	24.98	307.80		

FIG. 18A

THROUGH HOLE RADIUS $r=0.2\text{mm}$ RESONATOR THICKNESS $h=0.3\text{mm}$

θ (degree)	f (GHz)	Q	f _r (GHz)	Q _r	d (mm)	A (dB)
58.73296	21.20	373.42	20.15	13.44	1.62	-6.76
46.39951	22.25	385.89	21.92	36.17	1.38	-9.09
38.41832	22.92	396.71	22.82	102.00	1.18	-11.72
34.48327	23.23	402.40	23.19	178.75	1.08	-13.64
28.63711	23.67	410.76	23.66	335.74	0.91	-17.99
22.84636	24.05	417.45	24.05	412.84	0.74	-26.29
19.01041	24.29	423.34	24.28	422.97	0.62	-38.10
CYLINDER (THEORETICAL VALUE)	24.98	438.62	24.98	438.62		

FIG. 18B

THROUGH HOLE RADIUS $r=0.2\text{mm}$ RESONATOR THICKNESS $h=0.4\text{mm}$

θ (degree)	f (GHz)	Q	f _r (GHz)	Q _r	d (mm)	A (dB)
58.73296	21.21	463.75	20.15	13.53	1.62	-6.76
46.39951	22.26	480.94	21.93	36.84	1.38	-9.09
38.41832	22.92	495.16	22.82	107.45	1.18	-11.72
34.48327	23.24	503.41	23.19	195.99	1.08	-13.64
28.63711	23.67	515.04	23.66	401.13	0.91	-17.99
22.84636	24.06	525.97	24.06	518.37	0.74	-26.29
19.01041	24.29	533.65	24.29	533.29	0.62	-38.10
CYLINDER (THEORETICAL VALUE)	24.98	556.98	24.98	556.98		

FIG. 18C

THROUGH HOLE RADIUS $r=0.3\text{mm}$ RESONATOR THICKNESS $h=0.2\text{mm}$

θ (degree)	f (GHz)	Q	f_r (GHz)	Q_r	d (mm)	A (dB)
88.6634	19.55	263.96	17.35	9.15	2.00	-7.82
68.3	20.96	271.49	20.13	22.08	1.86	-9.30
55.9194	21.94	278.34	21.68	64.30	1.66	-11.83
49.969	22.41	282.28	22.30	119.23	1.53	-13.78
41.2709	23.07	288.40	23.05	236.72	1.32	-18.26
32.7863	23.65	294.21	23.64	290.88	1.08	-26.83
27.221	23.98	297.63	23.98	297.54	0.91	-39.03
CYLINDER (THEORETICAL VALUE)	24.98	307.80	24.98	307.80		

FIG. 19A

THROUGH HOLE RADIUS $r=0.3\text{mm}$ RESONATOR THICKNESS $h=0.3\text{mm}$

θ (degree)	f (GHz)	Q	f_r (GHz)	Q_r	d (mm)	A (dB)
88.6634	19.57	370.59	17.36	9.24	2.00	-7.82
68.3	20.98	379.74	20.14	22.60	1.86	-9.30
55.9194	21.95	389.69	21.69	68.81	1.66	-11.83
49.969	22.42	396.14	22.31	135.62	1.53	-13.78
41.2709	23.08	405.82	23.06	309.52	1.32	-18.26
32.7863	23.66	415.29	23.66	408.82	1.08	-26.83
27.221	23.99	419.58	23.99	420.83	0.91	-39.03
CYLINDER (THEORETICAL VALUE)	24.98	438.62	24.98	438.62		

FIG. 19B

THROUGH HOLE RADIUS $r=0.3\text{mm}$ RESONATOR THICKNESS $h=0.4\text{mm}$

θ (degree)	f (GHz)	Q	f_r (GHz)	Q_r	d (mm)	A (dB)
88.6634	19.57	464.32	17.36	9.29	2.00	-7.82
68.3	20.98	474.38	20.14	22.87	1.86	-9.30
55.9194	21.95	488.31	21.69	71.34	1.66	-11.83
49.969	22.43	496.31	22.31	145.64	1.53	-13.78
41.2709	23.09	509.64	23.07	367.81	1.32	-18.26
32.7863	23.66	522.94	23.66	513.03	1.08	-26.83
27.221	24.00	531.38	24.06	531.37	0.91	-39.03
CYLINDER (THEORETICAL VALUE)	24.98	556.98	24.98	556.98		

FIG. 19C

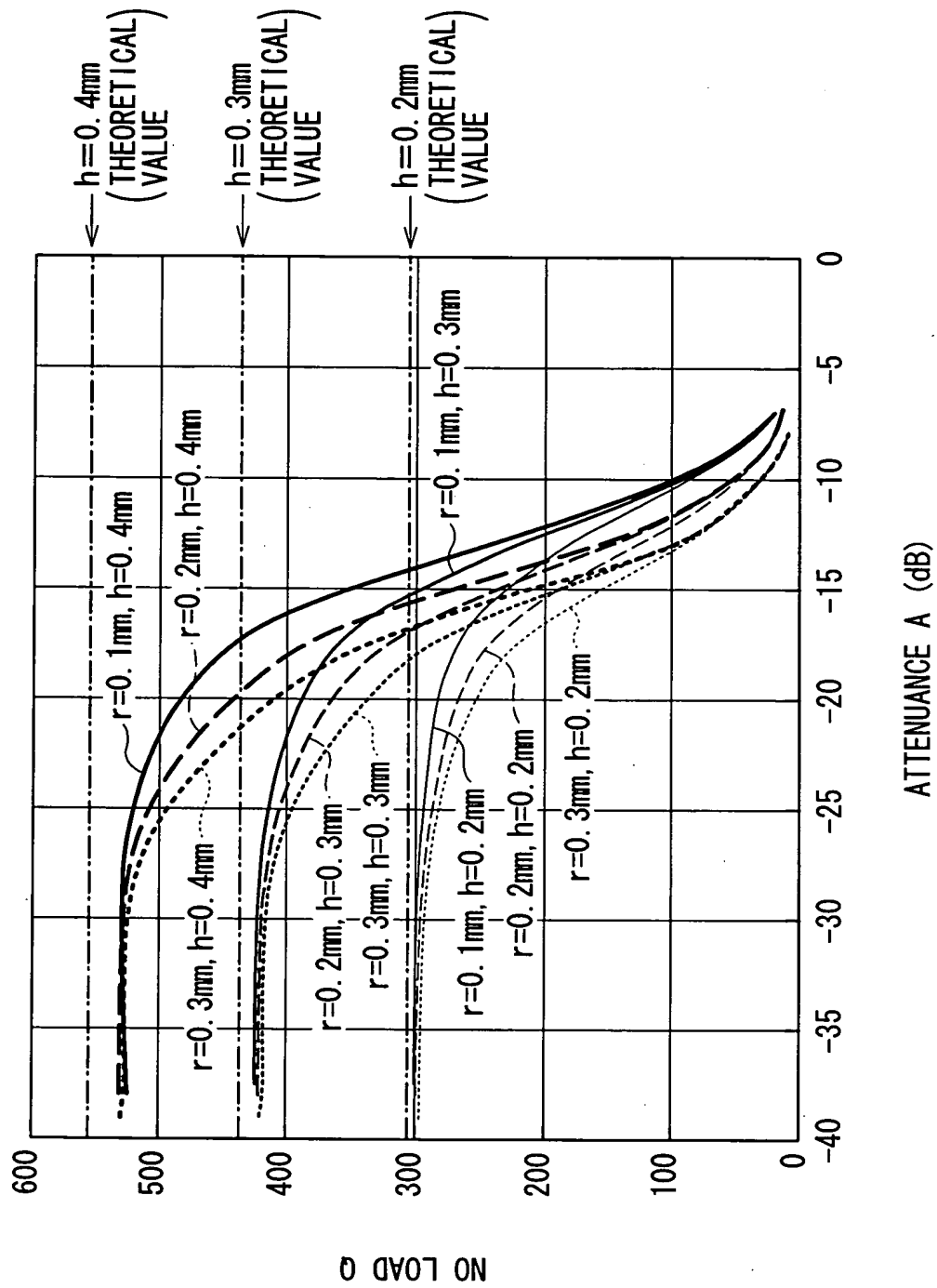


FIG. 20

FIG. 21A $r=0.1\text{mm}$

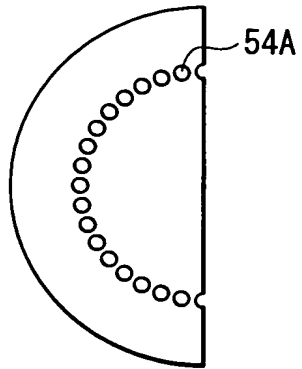


FIG. 21B $r=0.2\text{mm}$

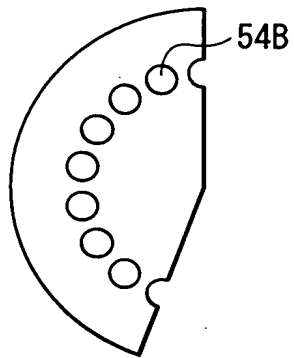


FIG. 21C $r=0.3\text{mm}$

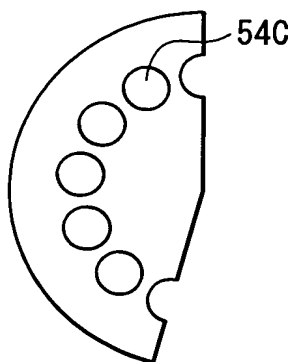


FIG. 22A $r=0.1\text{mm}$

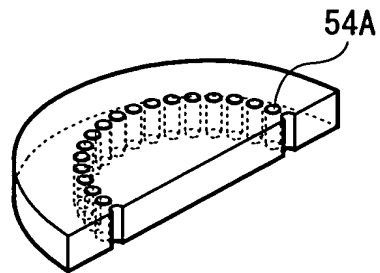


FIG. 22B $r=0.2\text{mm}$

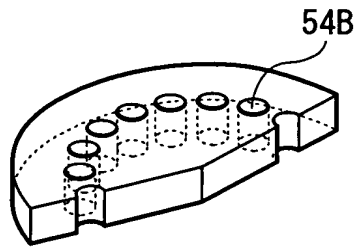


FIG. 22C $r=0.3\text{mm}$

